

## Definitions of Natural Resource Inventories, Monitoring, and Research

Natural resource inventories, monitoring, and research are closely-related activities needed for effective science-based management of park resources, and the terms are sometimes confused.

A **natural resource inventory** is an extensive point-in-time effort to determine location or condition of a resource, including the presence, class, distribution, and status of plants, animals, and abiotic components such as water, soils, landforms, and climate. Inventories contribute to a statement of park resources, which is best described in relation to a standard condition such as the natural or unimpaired state. Inventories may involve both the compilation of existing information and the acquisition of new information. They may be relative to either a particular point in space (synoptic) or time (temporal).

**Monitoring** differs from inventory in adding the dimension of time, and the general purpose of monitoring is to detect changes or trends in a resource. Elzinga et al. (1998) defined monitoring as "The collection and analysis of repeated observations or measurements to evaluate changes in condition and progress toward meeting a management objective". Natural resource monitoring is conducted primarily for two purposes: (1) to detect significant changes in resource abundance, condition, population structure, or ecological processes; or (2) to evaluate the effects of some management action on population or community dynamics or ecological processes. Detection of a change or trend may trigger a management action, or it may generate a new line of inquiry. Monitoring is often done by sampling the same sites over time, and these sites may be a subset of the sites sampled for the initial inventory. Cause and effect relationships usually cannot be demonstrated with monitoring data, but monitoring data might suggest a cause and effect relationship that can then be investigated with a research study. The key points in the definition of monitoring are that: (1) the same methods are used to take measurements over time; (2) monitoring is done for a specific purpose, usually to determine progress towards a management objective; and (3) some action will be taken based on the results, even if the action is to maintain the current management.

**Research** is generally defined as the systematic collection of data that produces new knowledge or relationships and usually involves an experimental approach, in which a hypothesis concerning the probable cause of an observation is tested in situations with and without the specified cause. Research has the objective of understanding ecological processes and in some cases determining the cause of changes observed by monitoring, which is needed for determining the appropriate management response to threats. In general, monitoring is the tool used to identify whether or not a change occurred and research is the tool to determine what caused the change. While it is often hoped that ecological monitoring can help to explain complex relationships in ecological systems, such understanding often requires a more focused research investment. The design of sampling protocols for various types of park resources at different locations and spatial scales requires a research effort, and is incorporated into the NPS approach for planning and designing long-term monitoring of park resources.